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Effect of fresh water algal extracts on carbohydrate content of cabbage *Brassica oleracea* L. var. Kranti- 18

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Abstract

A field experiments pertaining to the effect of foliar spray of algal extracts on carbohydrate content of cabbage vegetable crop (*Brassica oleracea* L.) var. Kranti- 18 were conducted during the period of March to June 2022- 2023 at agro-practices areas of Puntamba. The experiment was laid out in Randomized Block Design consisting of eight different treatments. Each experimental unit was repeated three times. The treatments were T₀, T₁, T₂, T₃, T₄, T₅, T₆ and T₇. The pragmatic results revealed that the impact of algal extracts on carbohydrate content of cabbage was found significant over the other treatments. Among various treatments, the lowest carbohydrate content of 100 mg/ gm was occurred in the treatment T₀ (Control). The foliar application of algal extracts treatments, *Lyngbya martensiana* (T₂) shows (179 mg/gm), *Hydrodictyon reticulatum* (T₄) shows (164 mg/gm), *Chara zeylanica* (T₁) recorded (184 mg/gm) and *Rhizoclonium crassipellitum* extract (T₃) recorded (172 mg/gm) most augmentation in carbohydrate content. While the Power Plant dose (T₆) treatment recorded (142 mg/gm) Carbohydrate content in the test plants resulting into encouraging increase and stands next to the algal extracts. While the Plantsol (T₅) and NPK (T₇) recorded less carbohydrate content as compare to algal extract i.e. (112 mg/gm) and (110 mg/gm) respectively.

Keywords: Extract, *Chara zeylanica*, *Rhizoclonium crassipellitum*, *Hydrodictyon reticulatum*, *Lyngbya martensiana*, NPK, Plantsol, Power plant

Introduction

Bio fertilization is a sustainable agricultural practice that includes using bio fertilizer to upsurge the nutrient content of the soil, resulting in higher productivity (Suleiman *et al.*, 2020) ^[14]. Algae, which are found in almost all terrestrial's environments are the most distinctive organisms on the planet with potential applications such as agricultural applications as bio fertilizers and soil conditioning agents for the improvement of soil fertility and plant productivity (Chapman, 2013, Duarte *et al.*, 2018) ^[6, 8].

Blue-green algal extract excretes a great number of substances that influence plant growth and development (Ordog 1999) ^[13]. These microorganisms have been reported to benefit plants by producing growth promoting regulators (the nature of which is said to resemble gibberellins and auxin polypeptides, antibacterial and antifungal substances that exert phytopathogen biocontrol and polymers, especially polysaccharides, that improve plant growth and productivity (Zaccaro *et al.*, 1999) ^[20]. Moreover, Zaccaro *et al.* (2001) ^[21] reported that, foliar application of biochemical organic substances is in demand which supply macro and micronutrients.

Fresh water algae distributed worldwide and improve the growth and development of the plants, with which they share the habitat, because they: 1- contribute to soil fertility in many ecosystems, 2- produce various biologically active substances and 3- have higher efficiency in bio absorption of heavy metals i.e. bioremediation (Zaccaro *et al.*, 2001) ^[21]. Moreover, hedge *et al.* (1999) documented that, application of algal bio fertilizers is useful for the reclamation of marginal soils such as saline-alkali and calcareous soils. Velasco- Ramirez *et al.* (2020) ^[17] studied by the extract of the seaweed *M. pyrifera* showed no significant effect on the stem length of *E. grandiflorum* var. Florida relative to the control plants. The average maximum stem lengths were respectively, 23.80 cm in the plants that received the foliar application, 20.8cm in those that received the extract directly to the substrate and just 18.4cm in the control plants.

Fresh water algae contain high percentage of macro and micronutrients bounded in their major biochemical constituents and metabolites such as carbohydrates and proteins (Wake *et al.*, 1992) [19]. In this respect, Adam (1999) found that algal filtrate of the Cyanobacteria *Nostoc muscorum* significantly increased germination of wheat seeds as well as their growth parameters and nitrogen compounds, as compared to untreated control. Also, Lozano *et al.* (1999) [12] stated that, the application of an extract from algae to soil or foliage increased ash, protein and carbohydrate contents of potatoes (*Solanum tuberosum*).

In the light of the above-mentioned reviews, it was of particular interest to investigate the effect of the four algal extracts; *Chara zeylanica* extract, *Lyngbya martensiana* extract, *Rhizoclonium crassipellitum* extract, *Hydrodictyon reticulatum* extract as T₁, T₂, T₃ and T₄ respectively on Carbohydrate content of Cabbage vegetable crop grown in black soil.

Materials and Methods

Preparation of Algal liquid extract

The algal extract was prepared by using the method of Bhosale *et al.* (1975) [5]. 10 grams of fine powder of selected fresh water algae, *Chara zeylanica*, *Lyngbya martensiana*, *Rhizoclonium crassipellitum* and *Hydrodictyon reticulatum* were mixed separately in 100 ml of sterile distilled water, boiled it up to final volume of about 10 ml. Extract was allowed to cool at room temperature. Then extract was filtered through double-layered muslin cloth. The extract was used as stock solution of concentration 100%. Then the extracts were diluted with sterile distilled water separately for the preparation of 1%, 5%, 10%, 15%, 20% and 25% concentrations and were stored in airtight stopper bottles separately. Thus, these prepared algal extracts of aforesaid concentrations were applied as liquid fertilizer for testing the seed germination and assessing the seedling growth of cabbage vegetable crops.

Results and Discussion

Selection of algae and determination of algal extract concentration

The potential of algal species as liquid fertilizer was considered on the basis of pragmatic results obtained. The extracts of collected algal species with different graded concentrations were tested on the seeds of Cabbage. During

the investigation, algal extracts of 15% *Chara zeylanica* and *Hydrodictyon reticulatum*; 20% *Lyngbya martensiana* and *Rhizoclonium crassipellitum* were showed observant and noteworthy increase in percent seed germination, root length, shoot length and total height of seedling over the control. Moreover, the higher algal extract concentrations above 25% where there was decreased seed germination and seedling growth over the control. Therefore, only using extracts of *Chara zeylanica* and *Hydrodictyon reticulatum* at 15% and *Lyngbya martensiana* and *Rhizoclonium crassipellitum* at 20% concentration level used on the test vegetables Cabbage owing to assess their effect on growth and carbohydrate content.

The Cabbage seeds were soaked in 15% concentration of *Chara zeylanica*, *Hydrodictyon reticulatum* and 20% concentration of *Lyngbya martensiana*, *Rhizoclonium crassipellitum* extracts and other different constraints for about 14 hours. There after the presoaked seeds were placed in the raised bed at 10- 12 cm distance and 1- 1.5 cm deep. After completion of the sowing, light irrigation was given. After four weeks, seedlings were ready for transplantation.

Foliar application of selected fresh water algal extracts

An experiment was planned in order to study the effect of fresh water algal extract namely, *Chara zeylanica*, *Lyngbya martensiana*, *Rhizoclonium crassipellitum* and *Hydrodictyon reticulatum* on growth and Carbohydrate of Cabbage (*Brassica oleracea* L.) var. Kranti- 18.

Field experiments for these test crops were conducted for test vegetable crops during the year 2022 - 2023. The treatments consist of 15% *Chara zeylanica* extract (T₁), 20% *Lyngbya martensiana* extract (T₂), 20% *Rhizoclonium crassipellitum* extract (T₃) and 15% *Hydrodictyon reticulatum* extract (T₄), Plantsol (T₅), Power plant (T₆) and Recommended dose of NPK (T₇) with untreated control (T₀) in randomized block design with three replications.

After transplanting the Cabbage seedlings at the 2 - 4 leaf stage, the first spray of respective concentrations of aforesaid treatments was given to the seedlings 15 days after sowing in the form of foliar spray. Then subsequent two more sprays were given to the test vegetable crops after fifteen days' interval.

The experimental plot was laid out in a Randomized Block Design (RBD) with seven treatments and one absolute (water sprayed) control, which were replicated in thrice.

Table 1: Treatments and concentrations of algal extracts, Plantsol, Power plant and Recommended dose of NPK applied on Cabbage

Sr. No.	Treatments	Symbol	Concentration	Cabbage	
				Spray	Time of spraying D.A.S.
1.	Control	T ₀	Distilled water	1 st 2 nd 3 rd 4 th	15 days
2.	<i>Chara zeylanica</i> extract	T ₁	15%		30 days
3.	<i>Lyngbya martensiana</i> extract	T ₂	20%		45 days
4.	<i>Rhizoclonium crassipellitum</i> extract	T ₃	20%		60 days
5.	<i>Hydrodictyon reticulatum</i> extract	T ₄	15%		
6.	Plantsol	T ₅	1 gm/ lit.		
7.	Power plant	T ₆	2 ml/ lit.		
8.	Recommended dose of NPK (Kg/ ha) 120: 60: 60	T ₇	2 gm/ lit.		

Experimental Plot Specifications

Specification	Cabbage
Crop variety	Kranti-18
Season	March- June
Gross plot size	3.6 X 3.0 m
Net plot size	3.0 X 2.5 m

Spacing	40X40cm
Treatments used	8
Replications	3
No. of plants	24
Source of irrigation	Well of farm

Spraying of algal liquid extracts, Power plant, Plantsol and Recommended dose on cabbage vegetable crop pre heading and Post heading.

Estimation of Total carbohydrates (mg/ gm)

In this context, pretreatment of Cabbage vegetable crop in the four algal filtrates, led to increase the Carbohydrate content (T₁, T₂, T₃ and T₄ respectively) as compare to the control, Plantsol, Power plant, and recommended dose (T₀, T₅, T₆ and T₇ respectively).

Table 2: Effect of algal extracts, Plantsol, Power plant and Recommended dose of NPK as foliar application on Carbohydrate content (Biochemical Content) of Cabbage (*Brassica oleracea* L.) var. Kranti- 18.

Sr. No.	Treatments	Symbol	Total Carbohydrates (mg/ gm)
1.	Control	T ₀	100
2.	<i>Chara zeylanica</i> extract	T ₁	184
3.	<i>Lyngbya martensiana</i> extract	T ₂	179
4.	<i>Rhizoclonium crassipellitum</i> extract	T ₃	172
5.	<i>Hydrodictyon reticulatum</i> extract	T ₄	164
6.	Plantsol	T ₅	112
7.	Power plant	T ₆	142
8.	Recommended dose of NPK	T ₇	110

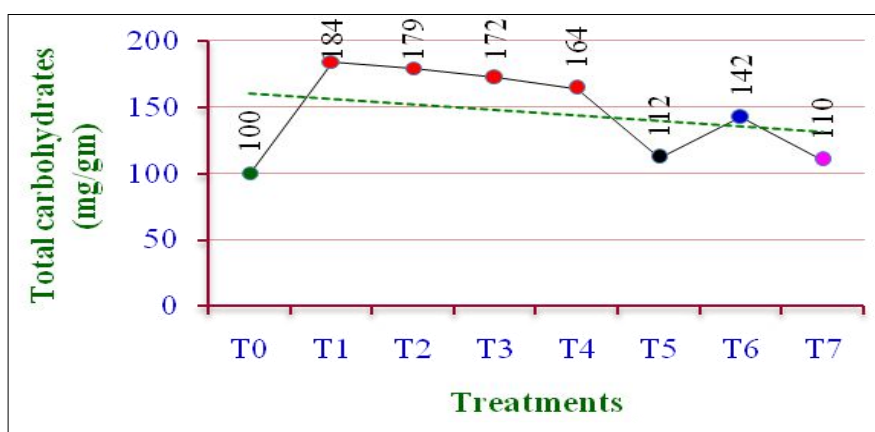


Fig 1: Effect of algal extracts, Plantsol, Power plant and Rec. NPK as foliar application on total carbohydrates content (mg/ gm) of Cabbage.

The total carbohydrates (mg/ gm) were estimated by first hydrolyzing the Cabbage head samples in dilute hydrochloric acid separately. Then, using anthrone reagent green coloured product was measured by taking absorbance at 630 nm wavelength.

With the view of the crucial role of total carbohydrate content in the plants as well as human metabolism as a important structural and storage component. More emphasis was given to find out the efficiency of algal extracts as well as commercial liquid fertilizers viz. Plantsol, Power plant and Recommended dose of NPK on total carbohydrate content in Cabbage heads. The pooled data in regards of total carbohydrate content (mg/ gm) in Cabbage heads was presented in Table- 1 and graphically illustrated in Fig. 1.

From the pragmatic results it was evident that, the total carbohydrate content in Cabbage head occurred in the range of minimum 100 mg/ gm to maximum 184 mg/ gm. The treatment T₁ (*Chara zeylanica* extract) recorded significantly highest amount of total carbohydrate content i.e. 184 mg/ gm and was on par with the treatment T₂.

This was followed by the treatments of *Lyngbya martensiana* extract (T₂), *Rhizoclonium crassipellitum* extract (T₃) and *Hydrodictyon reticulatum* extract (T₄) where correspondingly readings obtained were 179 mg/ gm,

172 mg/ gm and 164 mg/ gm total carbohydrate content. The treatment T₂ of *Lyngbya martensiana* extract was appeared to be on par with the treatment T₃. However, the treatment T₆ (Power plant) was found to be encouraging and positioned next to the algal extracts wherein total carbohydrate content noted was 142 mg/ gm. While, the T₅ (Plantsol) and T₇ (Recommended dose of NPK) treatments recorded moderate amount of 112 mg/ gm and 110 mg/ gm total carbohydrate content respectively and were on par to each other. Contrary to this, the minimum and lowest amount of total carbohydrate content i.e. 100 mg/ gm was observed in the treatment T₀ (Control).

The consequences the pragmatic result obtains in terms of increasing total carbohydrate content in cabbage are in accordance with the reports of Abhang (2009) who found the beneficial effects of blue green algal extracts sprayed foliarly. Di Filippo- Herrera *et al.*, (2019) [7] affirmed that extracts based on *M. pyrifera* were effective as a growth bio stimulant in mung beans. Sunarpi *et al.*, (2019) [15] noticed that the liquid fertilizer of the algae *Sargassum crassifolium* and *Sargassum aquifolium* significantly induced the height of the *Oryza sativa* plant.

The microalgae are frozen before freeze-drying to solidify the material at low temperatures. As the moisture content of

the microalgae declines, the product's solid structure and quality are preserved (Balasubramaniam *et al.* 2021)^[4]. The consequences of the result regarding the increasing total carbohydrate content with the imperative influence of studied algal extracts coincides with the reports of earlier workers the foliar application of seaweed extract to *Ambrosia melons* increased the sugar content by 2.3% more than untreated plants (Atkin *et al.* 1964). Hernandez - Herrera *et al.*, (2014)^[10] observed that the application of the seaweed extracts of *Ulva lactuca* and *Padina gymnoespora* via substrate in *S. lycopersicum* plants responded to a high germination percentage effect and consequently, increased vigor of the stem length.

Zaccaro *et al.* (2001)^[21] who documented that, the bio fertilizers are likely to assume greater significance as complement and/or supplement to chemical fertilizers in improving the nutrient supplies to cereal crops because of high nutrient turn-over in the cereal production system, exorbitant cost of fertilizers and greater consciousness on environmental protection.

Likewise, 1% seaweed liquid fertilizer obtained from *Padina pavonica* and *Sargassum plagiophyllum* showed accumulation of soluble sugar in ragi treated plants (Venkatramankumar and Mohan, 2000)^[18]. The sea weed extract treatments exhibited their most beneficial influence in terms of increasing total sugar content in Fenugreek (Khemnar, 2001)^[11]. LSF application increased the carbohydrate content in *Cyamopsis* (Thirumal and Thangam, 2003)^[16].

Conclusion

Without a doubt, the use of bio-fertilizer is the future of agriculture in the world, where it is expected to replace chemical fertilizer. because it is safer on the soil and also facilitates the process of biodegradation carried out by microorganisms, thus leads to an increase in soil fertility in a safe way without leaving chemical residues. We also expect to add nanomaterial to bio-fertilizer, as nanotechnology would provide green and efficient alternatives for the management of plant diseases and improve of plant resistance to environment stress and increase plant growth, yield productivity, and could increase the quality and quantity of plant.

The use of bio-organic fertilizers in agriculture has been recognized of late, as a better substitute to chemical fertilizer, in regard to the environment friendly attribute of the former and the harmful effect of the latter on human health. While, being environment friendly, bio-organic fertilizers, also improve the physical properties of the soil, water retention capacity, prevent nutrient depletion and add value to the crop grown.

To conclude, the fresh water filamentous algae as liquid fertilizer may prove efficient tool for boosting green revolution, to overcome food shortage all over the world and will be appeared highly beneficial to mankind. In regard, to this, as revealed in the present study, the effect of algal extract has showed best results in terms carbohydrate content of the crop, as against the use of chemical fertilizer and recommended use of NPK alone.

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